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ABSTRACT

Two readability formulas were applied to two math and two reading series textbooks at the fourth, fifth, and sixth grade levels to see whether the publishers' suggested reading levels were accurate. Five samples were taken from each text and compared to the publishers' suggested usage according to grade level. Results showed that although formulas agreed with the publishers' general readability averages, vast ranges of readability existed within specific units of texts. The study concludes that when considering a textbook for any course of study it would be wiser to look at specific unit readability levels rather than the general statistical average. (RL)

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READABILITY STUDY

IN

READING AND MATH

by

Joan M. Horn

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Submitted in partial fulfillment of the requirement
for the Master of Arts degree in Education at
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CHAPTER I

INTRODUCTION TO THE STUDY

INTRODUCTION

This study is concerned with the readability level of reading and math textbooks. As teachers become more aware of individual student differences within their classes the use of varied materials increases. Readability checks on these materials would aid any educator who is determining the appropriate text for their students. Often a single text will not suffice, children learning math, for example, might vary from a very concrete based program to extremely abstract units. However, many classrooms have a single manual in content areas for the whole grade level. How can everyone, with such a vast range of reading ability, function adequately with the same text? If education is going to meet the needs of all children it will have to start with the tools at hand. Comprehending the material presented will assist the students' retention powers, therefore a text at his readability level will be essential.

This research is based on the null hypothesis that there is no significant difference between the readability level of the manufactured texts and the skill, fluency

capabilities of that particular grade level.

STATEMENT OF THE PROBLEM

Are math and reading series appropriately matched to actual grade level fluency and individual students' reading levels?

This study investigates the readability of fourth, fifth, and sixth grade math and reading texts to determine their effectiveness within the classroom.

SIGNIFICANCE OF THE PROBLEM

Comprehension is the goal of reading, but can a person comprehend that which is not understood? Textbooks, not only basal readers but content area books as well, should challenge students. Very easy books become boring while extremely difficult material can cause a student to give up. How do we find the right material for each student? Readability checks on materials will help lead the way. Teachers aware of individual reading levels will be aided by readability information. Proper material can be obtained for whole classes or mini groups. Being observent of the readability level of texts used can create a new and exciting atmosphere in the classroom. It can present the same concept at different reading degrees thus stimulating all children. The classroom would not have to be a constant

struggle for some students and a leisure time for others.

PURPOSE OF THE STUDY

The purpose of this study is to investigate the readability level of two math and two reading texts on the fourth, fifth, and sixth grade levels.

> Ever since textbooks were first published by grade level they have been purchased for use at the designated level with little concern about whether or not the students could actually read the text.[1]

One manual will not avail itself to all readers especially in this period of individualization. The reason for reading is comprehension and retention, the only way to remember information is to understand what is read, and the only way to grasp written passages is to be able to read and decipher the printed words. It can be seen as a continuing circle, however, if the readability level is not correct for a student the circle stops and he is then left standing still or he returns to the same printed pages which caused confusion the first time. (see Figure 1). Textbooks of various readability levels would help all children succeed in the circle of understanding at their own degree of complexity.

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[1]Roger E. Johnson, "The Reading Level of Elementary Social Studies Textbooks is Going Down," The Reading Teacher, 30:901, May 1977.

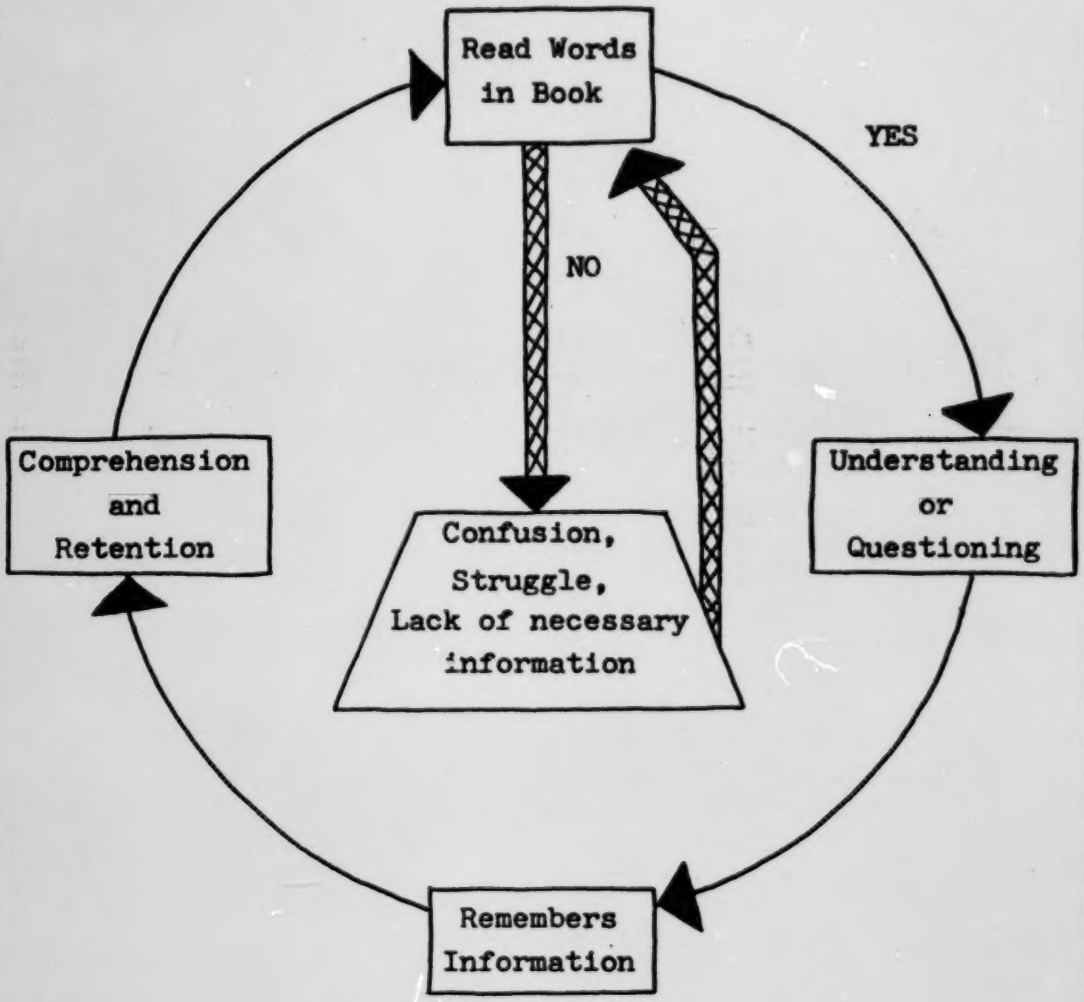

Figure 1 The Circle of Understanding For Any Given Manual

ASSUMPTIONS AND LIMITATIONS

This research study assumes that Fry's formula for estimating readability is an appropriate determiner and that all calculations done by the researcher are correctly reported. It is further assumed that all textbooks should have a readability level suited for each grade and that within each grade many reading levels are represented.

A limitation recognized by the researcher is that only one readability formula has been used and that only four textbook publishers are represented. It should also be noted that readability is but one indicator of difficulty, areas such as motivation and interest are also important factors.

DEFINITIONS OF IMPORTANT TERMS

While examining this research the reader should recognize the term readability to be the measure of difficulty or complexity of any printed material.[2] Readability levels are an "indication of the difficulty of reading material in terms of the grade level at which it might be expected to be read easily."[3]

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[2]Clifford L. Bush and Robert C. Andrews, Dictionary of Reading and Learning Disability Terms (New Jersey: Educational and Psychological Associates Press, 1973), p. 68.

[3]ibid.

The Readability Formula, a method used to check the reading level of printed matter, used in this research will be based on the Fry Formula Graph and the Fry Readability Scale. The Fry Readability Graph is a formula for estimating readability devised by Edward Fry from Rutgers University Reading Center, New Jersey. This procedure consists of three random selections of 100 word passages. The average number of syllables and sentences are then graphed to determine the grade level of the material. Reliability is usually within one grade level.[4] A sliding chart used to calculate the Fry Readability Graph is known as the Fry Readability Scale.

SUMMARY

Two math and two reading textbooks on the fourth, fifth, and sixth grade levels were used in this study to determine the publishers' accuracy when identifying their material according to the appropriate grade usage.

It is very important that "...in reading, the teacher must know both the instructional level of the child and the difficulty of the material that the child is

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[4]Edward Fry, The Emergency Reading Teacher's Manual (New Jersey: Dreier Educational Systems, Inc., 1969), p. 16.

expected to read."[5] Just looking at a passage will not give an accurate estimate of difficulty, therefore instructors must either provide their own readability checks on available material, or accept the publishers' opinion of the textbook difficulty. Examining the possibility of using the publishers' judgment is the basis of this research.

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[5]Walter Feinberg, "The Teacher and His Materials: A View of Accountability From Inside," The Elementary School Journal, 73:350, April 1973.

CHAPTER II

REVIEW OF RELATED LITERATURE

INTRODUCTION

Readability formulas are just measuring tools, they're not infalliable or exact, however they do guide judgments with reasonable accuracy. Some formulas tend to be long and time consuming, others short and quick, but all formulas attempt to help evaluate the anticipated difficulty of printed material. This chapter introduces different types of readability formulas and explains the purposes for using the Fry Readability Scale.

BRIEF HISTORY OF READABILITY FORMULAS

The concern of educators to evaluate printed matter goes back many years. As early as 1923 Lively and Pressey divised a formula to measure "...vocabulary difficulty in supplementary reading material..."[1] They chose 1000 word sample units in conjunction with the total number of pages in the book and the approximate number of words per line

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[1]Bertha A. Lively and S. L. Pressey, "Educational Administration and Supervision Including Teacher Training," Educational Administration and Supervision, 9:389, October 1923.

to estimate the number of pages which would be sampled. The total number of different words was checked with the Thorndike Word Book, then the words were counted and a vocabulary burden of difficulty was indicated for that particular text.[2] A few years later "Carleton Washburne and Mabel Vogel (1926) used Lively and Pressey's formula to analyze 700 books..."[3] They researched the grade placement of children's reading material through the use of structural difficulty not content difficulty. It is important to note that "...Vogel and Washburne base their formula primarily upon children's voluntary readings of fiction or fictionized material."[4] This would indicate that interest and motivation have some controlling influence on the results.

> The work of Washburne and Vogel was important not only in that it was the first validation study of a formula element using an outside criterion, but also because it provided a base upon which these authors could construct their own readability formula. Their technique, in turn is of special interest because it represents the prototype of modern readability formulas.[5]

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[2] ibid. pp. 389-98.

[3] George Klare, The Measurement of Readability (Iowa: Iowa State University Press, 1963), p. 38.

[4] Irving Lorge, "Readability Formulae - An Evaluation," Elementary English, 26:90, February 1949.

[5] Klare, op. cit., p. 39.

In the years which ensued many formulae followed. (see Figure 2) The Lorge formula (1939) referred to readability in relation to grade scores using "the relative number of different uncommon words, the average sentence length, and the relative number of prepositional phrases"[6] as their procedure. In 1943 Rudolf Flesch produced his readability formula using three factors. These three factors involved "...average sentence length, a relative number of affixed morphemes (prefixes, suffixes, inflectional endings), and a relative number of personal references."[7] Dale and Chall (1948) introduced a formula using a list of 3000 common words. Until then readability formulas had been difficult and time consuming. The Dale-Chall procedure was "...a simple, two factor formula that is easy to apply."[8] The Dale-Chall formula incorporates a vocabulary load (the words found outside the 3000 words in the Dale list) and sentence structure using average sentence length.[9] This formula is still being used today.

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[6]Edgar Dale and Jeanne S. Chall, "A Formula for Predicting Readability," Educational Research Bulletin, 27:12 January 1948.

[7]ibid.

[8]ibid. p. 19.

[9]ibid.

HISTORY OF READABILITY

Author	Range of Difficulty	Date
Lively and Pressey	2 - College	1923
Vogel and Washburne	3 - 9	1928
Dolch	P - 4	1928
Lewerenz	2 - College	1929
Lewerenz	2 - College	1930
Lewerenz	2 - College	1935
Lewerenz	2 - College	1939
Johnson	P - 8	1930
Patty and Painter	4 - 12	1931
Ojemann	8 - College	1934
Dale and Tyler	P - 8	1934
McClusky	8 - Adult	1934
Gray and Leary	2 - College	1935
Bergman	1 - 9	1936
Morriss and Halverson	Adult	1938
Washburne and Morphett	1 - 9	1938
Lorge	3 - 12	1939
Yoakam	4 - High School	1939
Kessler	2 - College	1941
Flesch	3 - 12	1943
Flesch	3 - 12	1948
Edgerton	Children's Level	1945
Lorge	3 - 12	1948
Dolch	1 - 6	1948
Wheeler and Wheeler	Children's Level	1948
Dale and Chall	3 - 12	1948
Flesch	3 - 12	1950
SRA	P - and up	1950
Farr, Jenkins and Paterson	Adult	1951
Gunning	6 - 12	1952
McElroy	Adult	1953

Author	Range of Difficulty	Date
Forbes and Cottle	5 - College	1953
Spache	1 - 3	1953
Wheeler and Smith	P - 4	1954
Flesch	Adult	1954
Tribe	2 - 8	1956
Gillie	3 - 12	1957
Stone	1 - 3	1957
Powers, Sumner and Kearl	3 - 8	1958
Flesch	Adult	1958
Bloomer	P - 6	1959
Botel	P - and up	1962
Fry	P - and up	1968
McLaughen "SMOG"	P - and up	1969
Kretschmer	P - and up	1976

Figure 2 HISTORY OF READABILITY

Adapted from Table 1

George Klare, The Measurement of Readability (Iowa: Iowa State University Press, 1963).

Dr. Edward Fry created a formula (1968) based on the Flesch example that saves time relying on average sentence length and the number of syllables in the sample.

> There was a feeling that these shorter formulas were not as accurate as the lengthier procedures, and Fry himself stated that his method was accurate to "within a grade level." (Fry 1968) However, the sacrifice in accuracy was considered a fair price for the time saved."[10]

The McLaughen formula, known as "SMOG" (1969) uses the average number of three or more syllable words to find grade levels of readability.

> McLaughten did state, that his grade-levels tend to be rather high because his grades reflect the levels which a reader needs to ensure complete comprehension, whereas, the Dale-Chall levels indicate the grade at which a book or article can be read with understanding."[11]

The time saved by these newer readability formulas must be considered when deciding upon one for a given purpose. If specific accuracy is essential in the investigation, it has been found that the Dale-Chall formula is the most widely recommended. However, classroom teachers need quick results. It has been observed that "Fry's method

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[10]Joseph C. Kretschmer, "Updating the Fry Readability Formula," The Reading Teacher, 29:555-6, March 1976.

[11]Walter Pauk, "A Practical Note on Readability Formulas," Journal of Reading, 13:209, December 1969.

yielded grade levels which were identical to those obtained by using the Dale-Chall formula. And in only two cases (out of twenty) was the variance more than two grades."[12] Since the Dale-Chall formula requires approximately forty minutes and the Fry formula about fifteen it is reasonable to assume that the speed of calculations would outweigh the slight edge of accuracy for most practical purposes.

CHOOSING THE FRY READABILITY SCALE

> Selecting the right reading material for your student is one of your most important jobs. If you give a student material that is too hard for him, the student will become bored with it and may stop reading, or his comprehension of the material will be poor. Even if he does struggle through it, it will take an excessive amount of time. On the other hand, if the student is given material that is too easy (which is not often the case), he may find it "babyish" and again become bored and stop reading.[13]

Therefore readability formulas must be quick enough to be expedient for classroom teachers and accurate enough to be useful. "The teacher who understands the basic principles of readability is better able to make informal judgments concerning the suitability of a book for a

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[12] ibid.

[13] Edward Fry, The Emergency Reading Teacher's Manual (New Jersey: Dreier Educational Systems, Inc., 1969), p. 15.

particular grade or an individual child."[14] The Fry Readability Graph has shown to be highly correlated with other well-known formulas in providing teachers with the fastest and easiest measure of readability. (Klare 1974-5 and Cardinell 1976). Joseph L. Vaughan, Jr., (1976) in recent studies concluded that plus or minus one full grade would be a safe range for assessing readability. His studies find the Dale-Chall and Fry scores to be consistently agreeable. Fry himself has tested his formula and determined that "it correlates highly with the Dale-Chall, SRA, Flesch and Spache formulas."[15]

A correction procedure has been suggested by Kretschmer (1976) for the Fry formula. This revision is concerned with syllable count because "one problem with estimating vocabulary difficulty by number of syllables is some difficult words such as heir and argot are rather small, while certain easy words like into and every have two and three syllables."[16] The simple correction identifies a list of 50 basic words of two or three syllables and counts them

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[14]Miles A. Tinker and Constance M. McCullough, Teaching Elementary Reading (New York: Appleton-Century-Crofts, 1968), p. 302.

[15]Edward Fry, "A Readability Formula That Saves Time," Journal of Reading, 11:577, April 1968.

[16]Joseph C. Kretschmer, "Updating the Fry Readability Formula," The Reading Teacher, 29:556, March 1976.

as one syllable. The margin of error between the Fry formula and the Dale-Chall or Spache formulas appears to be smaller when using Kretschmer's correction formula. Further research and investigation of this issue should be considered.

ESTIMATING READABILITY

Attempts have been made to estimate readability without a formula, however this hasn't been very successful. Russell and Merrill (1951) chose 63 librarians in 10 different states to visually judge 60 books ranging from third to fifth grades. After comparing the opinions of all librarians to six traditional readability formulas they found that

> in general, children's librarians do not agree closely with one another in rating the difficulty of juvenile books...For the most part, school librarians tended to rate the books more difficult than did the public librarians.[17]

Furthermore the estimates varied from three to nine grade levels. Jorgenson (1975 polled 84 elementary school teachers to observe their estimates of readability levels on specifically graded paragraphs. The easiest paragraphs were accurately judged, however as the difficulty of the selected passage increased the estimates reflecting grade levels

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[17]Eugene A. Jongsma, "The Difficulty of Children's Books: Librarians' Judgments Verses Formula Estimates," Elementary English, 49:20-6, January 1972.

widened. On the whole "...the results of the present study indicate that elementary school teachers vary widely in their ability to judge accurately the difficulty level of paragraphs from various grades, and that a common sense of "grade level" does not exist."[18] Considering that each teacher would tend to judge passages according to the level of work they observe everyday it can be conceived that an instructor of a bright fifth grade would estimate readability differently from a teacher of an average or slow fifth grade. Personal opinion encompasses too great a scope to validly judge levels of printed material.

THE RELEVANCE OF READABILITY FORMULAS TO MATHEMATICS

Readability of mathematic books is a controversial issue, in fact "it has been suggested by some that readability formulae actually are not appropriate for application to mathematics materials due to the specialized vocabulary and reading skills involved."[19] Nevertheless, students do have most of their difficulty with word problems and instructions which tend to indicate a need for a readability check of these areas. Smith and Heddens (1964) used the

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[18]Gerald W. Jorgenson, "An Analysis of Teacher Judgments of Reading Level," American Educational Research Journal, 12:67-75, Winter 1975.

[19]Kenneth J. Smith, "The Application of Readability Formulae to Mathematics TextMaterials: A Note," The Arithmetic Teacher, 12:355, May 1965.

Spache readability formula to test primary mathematic material. The results indicated that "...the average grade levels tend to be considerably higher than the assigned grade levels of the materials, particularly at Grade 1. The materials for Grade 1 seem to be about as difficult as those for Grade 3."[20] They also found that even though the book appears to be on level with the average ability of a grade some parts are excessively difficult. The books don't range from easy to hard progressively increasing in difficulty, therefore students will continually be staggered along the way by sections which overwhelm them. Since the purpose of a mathematics textbook is to teach computations the reading aspects should be at the class' independent reading level. (This level is indicated by an ease of reading with 90% comprehension.) If the words cause confusion the computations won't take place. Heddens and Smith (1964) selected five commercial arithmetic textbooks for grades 1 - 6 to examine. They concluded "...that the reading level of the text should be at a level lower than the grade in which the material is to be used."[21] They also suggest that books

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[20]Kenneth J. Smith and James W. Heddens, "The Readability of Experimental Mathematics Material," The Arithmetic Teacher, 11:392, October 1964.

[21]James W. Heddens and Kenneth J. Smith, "The Readability of Elementary Mathematics Books," The Arithmetic Teacher, 11:466-68, November 1964.

should ideally become progressively more difficult. "If educators are to be successful in teaching arithmetic, either the reading level of the arithmetic material must be lower or the reading level of the child must be improved, or both."[22] Wiegant (1967) examined the mathematics textbooks of the Pittsburgh Public Schools and found that the texts were "...consistently higher than the performance levels of most...students."[23] Smith (1969) used the Dale-Chall formula to investigate the readability of Junior High Mathematic Textbooks and found that on the seventh grade level only six of the eleven texts used had reading levels appropriate for their intended grade and on the eighth grade level five of eleven were accurate.[24] All of these studies indicate a need to further investigate the material being given to students and their appropriate usefulness.

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[22] ibid. p. 468.

[23] Regis B. Wiegand, "Pittsburgh Looks at the Readability of Mathematics Textbooks," Journal of Reading, 11:201-4, December 1967.

[24] Frank Smith, "The Readability of Junior High School Mathematics Textbooks," The Mathematic Teacher, 62:289-91, April 1969.

CONCLUSION

Readability checks are not the answer to all the difficulties children have in their academic pursuits, but they form one element to be observed. Students still need structured lessons in study skills and various content areas. They need to develop their motivation for learning and increase their interests in many directions. Readability formulas should be used by instructors to increase their own awareness of the level of difficulty the students will encounter when reading the text. If the prescribed book for a particular course proves to be too easy for a specific class, additional information can be used; on the other hand, if the textbook is too difficult the teacher has several options to investigate. Texts which require a higher reading ability than the class exhibits can be carefully outlined by the instructor, rewritten, read and discussed after specific instruction in vocabulary and structural analysis, or if possible a substitute text could be introduced. The main contribution to difficult texts is the added input a teacher must include and incorporate into the subject.

"In a recent article on the readability principle, Fry (1975) writes that high motivation overcomes high readability but low motivation demands low readability."[25]

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[25]Gloria Dorwart, "A Comparison of Trade Books and Special Series Books for Remedial Readers," Unpublished Article 1976 ERIC: ED 124 891.

Interest and motivation can increase readability, however they can not be depended upon. Since interest and motivation are both involved with feelings they will not remain constant, especially if the student is always struggling to read the material.

The formulas themselves must be recognized for their intended purpose. Readability formulas measure words according to their structural difficulty, assuming that longer words are harder to read than shorter ones.

> No formula measures sentence organization or work order. Nor is there a formula that considers format or imagery in writing...Style isn't measured. And the only thing needed to make a hard "bad" writing "good" is to just use easy words and shorter sentences.[26]

That is why the teacher is still an important element in interpreting readability scales, it takes wise judgments and practical experience to objectively evaluate textbooks.

Each teacher regardless of his field of specialty must accept the role of reading teacher, incorporating vocabulary, word recognition, comprehension skills, and study skills into his content area. Then students will have the tools to deal with the information presented and obtain the maximum knowledge from their education.

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[26]Mary L. Peters, "My Weekly Reader...Can I Read It?," Learning Today, 8:43-4, Summer 1975.

CHAPTER III

DESIGN OF THE STUDY

INTRODUCTION

The purpose of this study is to determine reliability of specific publishers' texts when comparing their suggested grade levels to an actual readability formula.

PROCEDURES USED

The researcher analyzed the readability levels of four textbooks through the use of the Fry Readability Graph. Results were compared with each company's evaluated grade level and conclusions were then tabulated.

SOURCES OF DATA

Both Addison-Wesley Publishing Company (1971) and Harcourt Brace Jovanovich Inc. (1972) were used for investigation of mathematic readability at the fourth, fifth, and sixth grade levels.

The following reading texts were evaluated: Ginn and Company (Reading 360) was analyzed for levels ten through thirteen. Harper and Row Publishers were observed within levels thirteen and eighteen.

METHODS OF GATHERING DATA

The Fry Readability Graph, developed by Dr. Edward Fry of Rutgers University, New Jersey, was chosen because of its high correlation with the Dale-Chall formula and for its ease and speed of calculations. In addition to the Fry Scale a comparison of Kretschmer's correction formula has been included.

The Fry Readability Graph suggests choosing three passages of one hundred words. The average number of syllables and the average sentence length are then plotted on the graph to determine the approximate grade level. The researcher has choosen five passages at each level to allow for a more accurate estimate of the texts involved.

Kretschmer's formula, devised in 1976 includes a word list of 50 easy two or three syllable words which are counted as one syllable. The purpose of the correction formula is to eliminate the error due to an over-amplified degree of syllabication of basic words.

SUMMARY

This research compares two math and two reading text book series on the fourth, fifth, and sixth grade levels. The Fry Readability Graph has been used to determine the appropriate grade usage of each level. The Kretschmer correction formula is also included as a means of evaluation.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

INTRODUCTION

The purpose of this study is to correlate the accuracy of the publishers' suggested grade level to actual analysis of each text according to the Fry Readability Graph and the Kretschmer Correction Formula.

This chapter is a presentation of all data which have been compiled for this research.

DATA

Findings of Basal Readabilities

Ginn and Company (360 Reading). The Ginn 360 Reading series is composed of thirteen levels. This particular publisher does not indicate corresponding traditional grade units, however, level eleven is the first text to emphasize intermediate reading instruction. Therefore, the researcher has devised the following chart of Ginn 360 Reading levels (10 - 13) with their equivalent school grade.

Ginn 360 Reading Levels	School Grade
Level 10	3
Level 11 (Intermediate)	4
Level 12	5
Level 13	6

Level 10 - All Sorts of Things. According to the Fry Readability Graph, Level 10 is suitable for third grade usage. Five random samples were examined, three of the five were at the third grade level while two selections were somewhat easier indicating the second grade readability. The Kretschmer correction agrees with the Fry graph in four out of five situations. Overall, both the Fry Graph and the Kretschmer Correction Formula judge Level 10 to be a third grade text, thus agreeing with the publisher. (see Figure 3)

Level 11 - The Sun That Warms. This text is extremely varied in its scope. The range of readability is from second to seventh grades. The average readability indicates the fourth grade level according to Fry and third grade according to Kretschmer, which is very close to the publishers' suggested fourth grade usage. However, since a wide range of readability exists, this text needs to be examined carefully before being implemented. (see Figure 4)

Level 12 - On The Edge. Ginn and Company recommended Level 12 as the second intermediate text (grade 5). Both the Fry Graph and the Kretschmer formula rank this

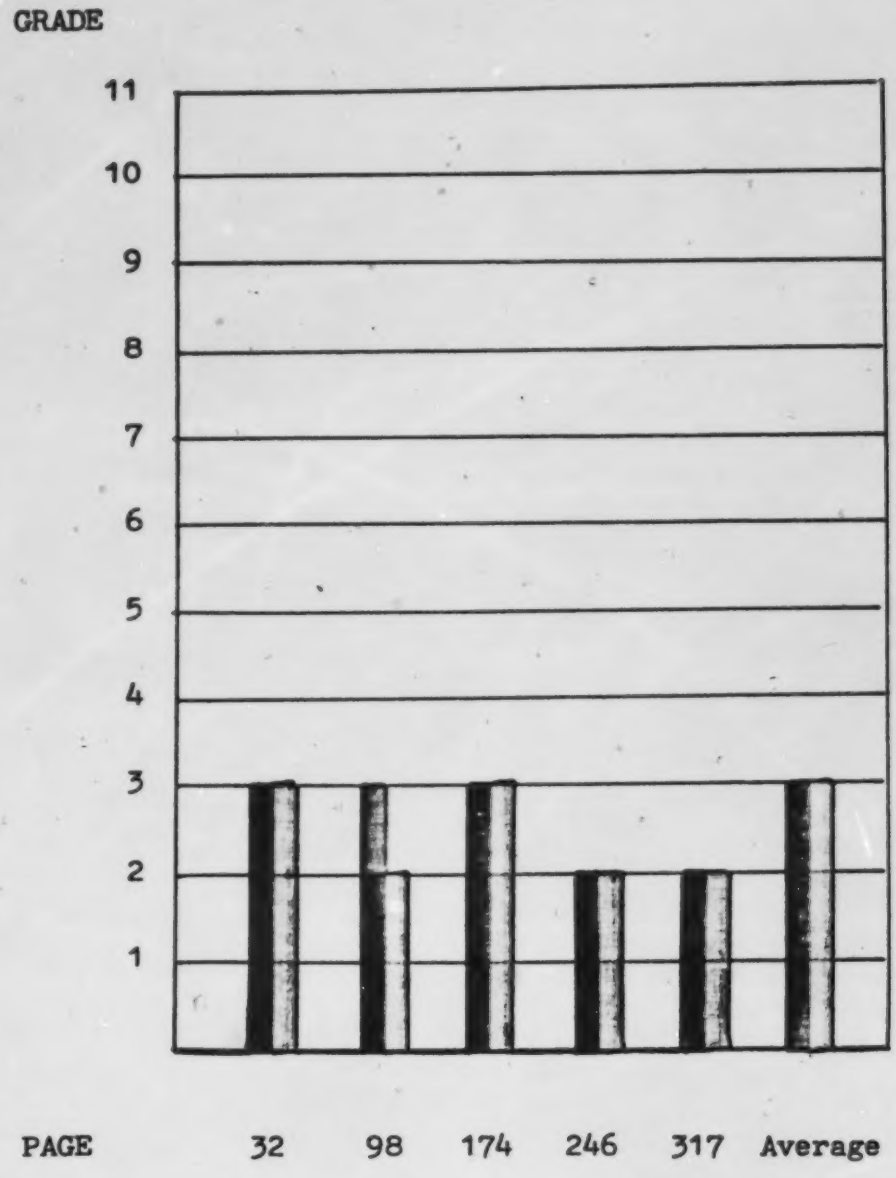


Figure 3 Readability: All Sorts Of Things

Ginn and Company

(360 Reading)

Level 10

Fry [redacted] Kretschmer [redacted]

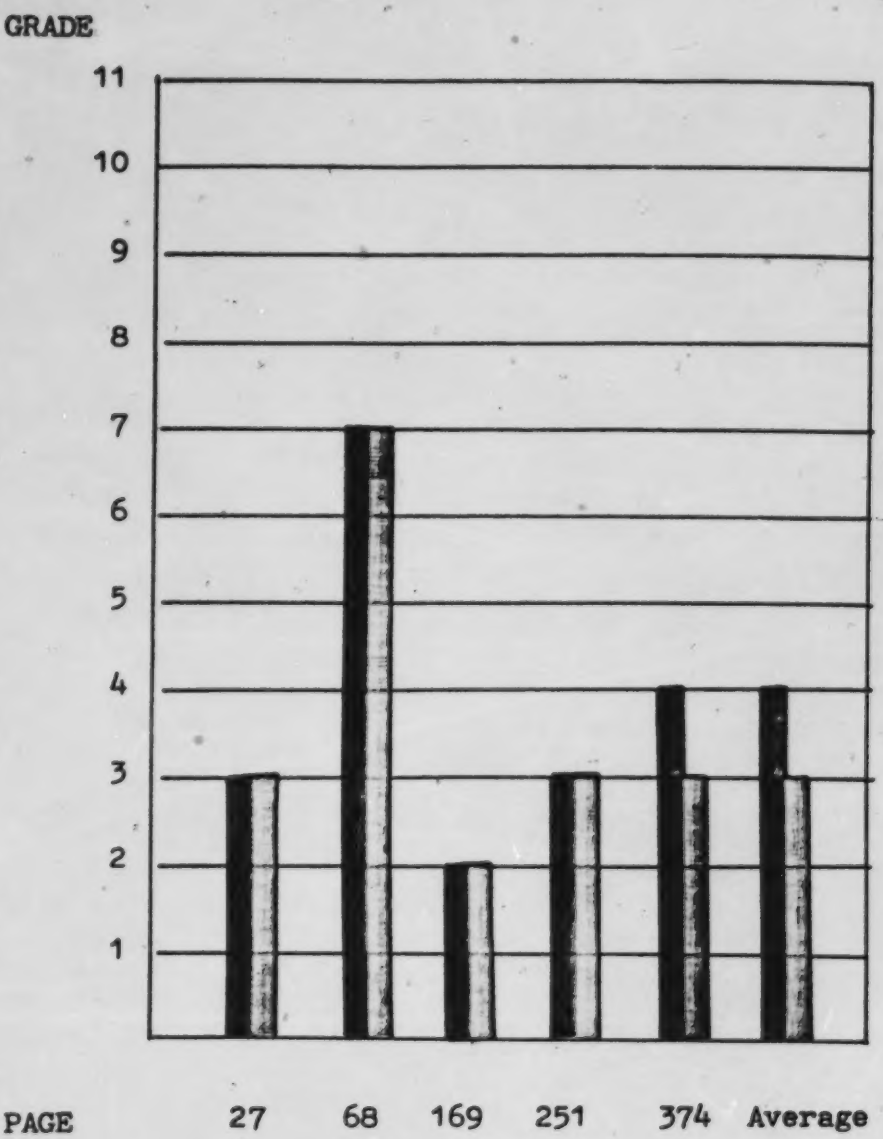


Figure 4 Readability: The Sun That Warms

Ginn and Company

(360 Reading)

Level 11

Fry ▬ Kretschmer ▬

basal as a sixth grade unit which is one year above the desired grade placement. The Fry formula illustrates three selections at sixth grade, one at seventh and one at fifth. The span between Level 11 and Level 12 in this particular basal series encompasses three grades. (Grades 4 - 6) (see Figure 5).

Level 13 - To Turn A Stone. This book, according to Fry, ranges from fourth to ninth grades. The Kretschmer formula shows Level 13 to be a span of third to eighth grades. Ginn and Company recommended this text to be used with sixth graders. Although both formulas show a sixth grade average readability, none of the specific units can be found at that level. They all signify either higher or lower readability. (see Figure 6).

A general observation of the Ginn 360 Reading system would indicate that the publisher has designated each text for the appropriate grade, with the exclusion of Level 12 which is at a somewhat higher readability than fifth grade. This generalization is misleading due to the fact that each level has a wide dispersity among itself. (see Figure 7).

Harper and Row Publishers. The Harper and Row reading series consists of eighteen levels. Levels 14, 16, and 18 are content area skill builders. Each of these levels divides the text into five sections:

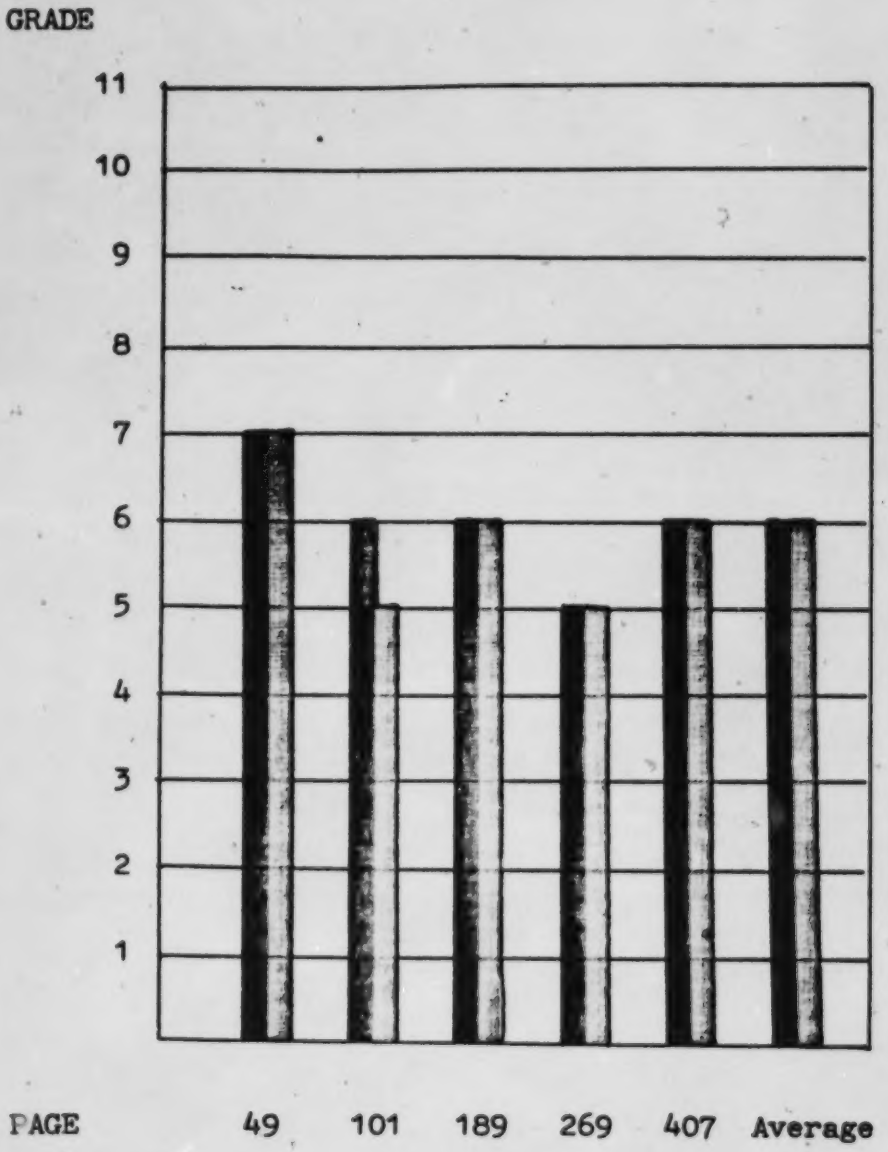


Figure 5 Readability: On The Edge

Ginn and Company

(360 Reading)

Level 12

Fry [redacted] Kretschmer [redacted]

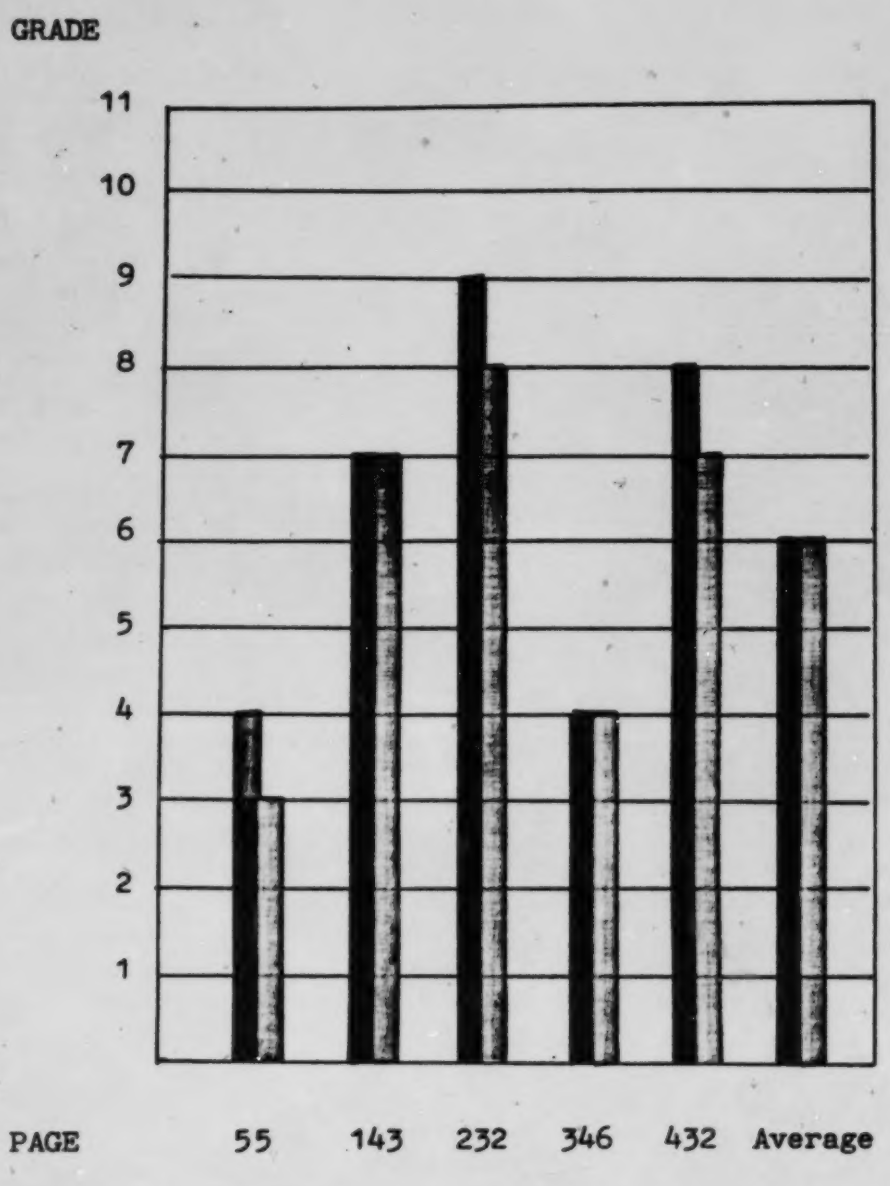


Figure 6 Readability: To Turn A Stone

Ginn and Company

(360 Reading)

Level 13

Fry [redacted] Kretschmer [redacted]

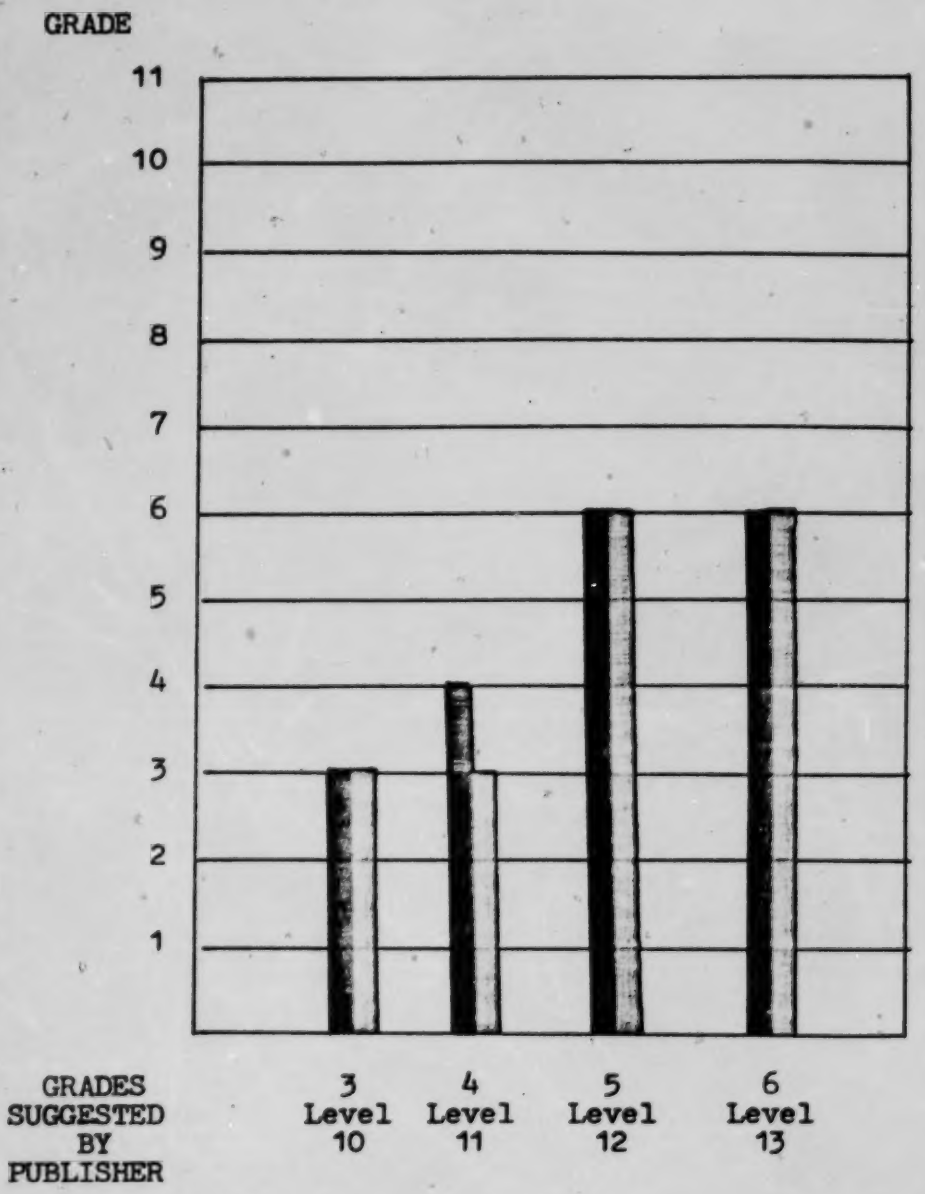


Figure 7 Grade Averages According to Formulas and Publisher Ginn and Company (360 Reading)

Units in Content Area Texts
You and Reading
How to Read Science
How to Read Social Studies
How to Read Mathematics
How to Read Literature

Level 14 is designed for use in fourth grade after the completion of Level 13; Level 16 is intended as a subject matter skill builder in fifth grade after Level 15 has been mastered; and Level 18 contains content material to be used in sixth grade after Level 17 has been read. The following chart examplifies these levels.

Harper and Row Levels	School Grade
Level 13	4 (Reader)
Level 14	4 (Content Skill)
Level 15	5 (Reader)
Level 16	5 (Content Skill)
Level 17	6 (Reader)
Level 18	6 (Content Skill)

Level 13 - Traveling The Trade Wind. The average readability of this text according to the Fry Graph and Kretschmer's correction formula is third grade. Harper and Row suggest Level 13 to be used for fourth grade. A close examination of this particular level demonstrates that page 92 cannot be evaluated and both pages 21 and 372 are at the seventh grade level. The wide variety of readability tends

to make the average insignificant. (see Figure 8)

Level 14 - From Pyramids to Princes. Level 14 is the first book of subject matter skills. The average readability is analyzed at grade six, however, Harper and Row suggests fourth grade for this basal. The Fry formula indicates that none of the subject areas are below the fifth grade ability, and Kretschmer only signifys the science area to be on a fourth grade level. The span of readability levels in this section are closely related, however, they are all above the publishers' suggested level of competency. (see Figure 9)

Level 15 - Coming To Crossroads. Harper and Row suggest Level 15 to be used as the fifth grade reader. The two formulas used found fourth grade to be the average readability. Although the average is easier than the implied grade there is a gradual increase of difficulty thus creating a steady growth throughout the text. (see Figure 10)

Level 16 - From Falcons to Forests. Level 16 is the fifth grade content area skill reader. The Fry formula points out that only one area, "How to Read Mathematics" is below the fifth grade level. All other units are above the grade readability, especially science at grade 10. (see Figure 11)

Level 17 - Spanning The Seven Seas. Level 17 has uneven readability. The average, according to the analyzed formulas, appears to be sixth grade, the exact grade Harper

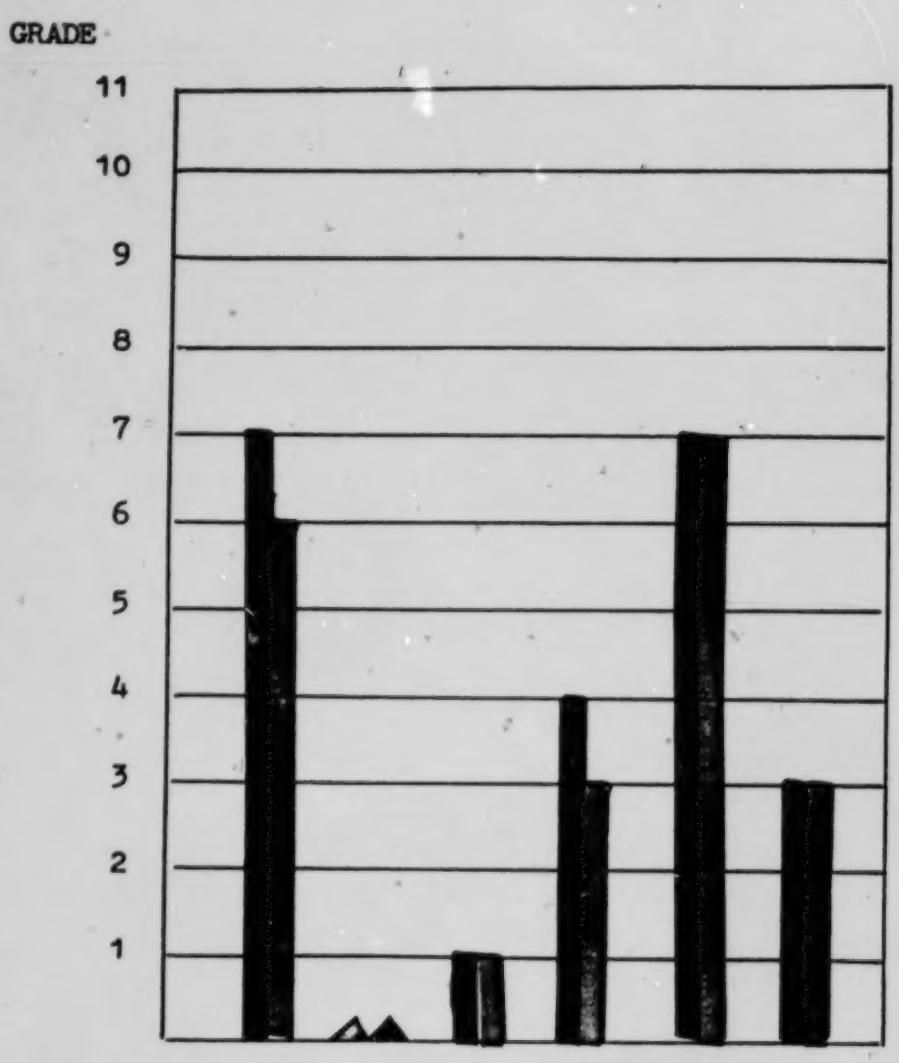


Figure 8 Readability: Traveling The Trade Wind

Harper and Row

Level 13

Fry ■ Kretschmer ■

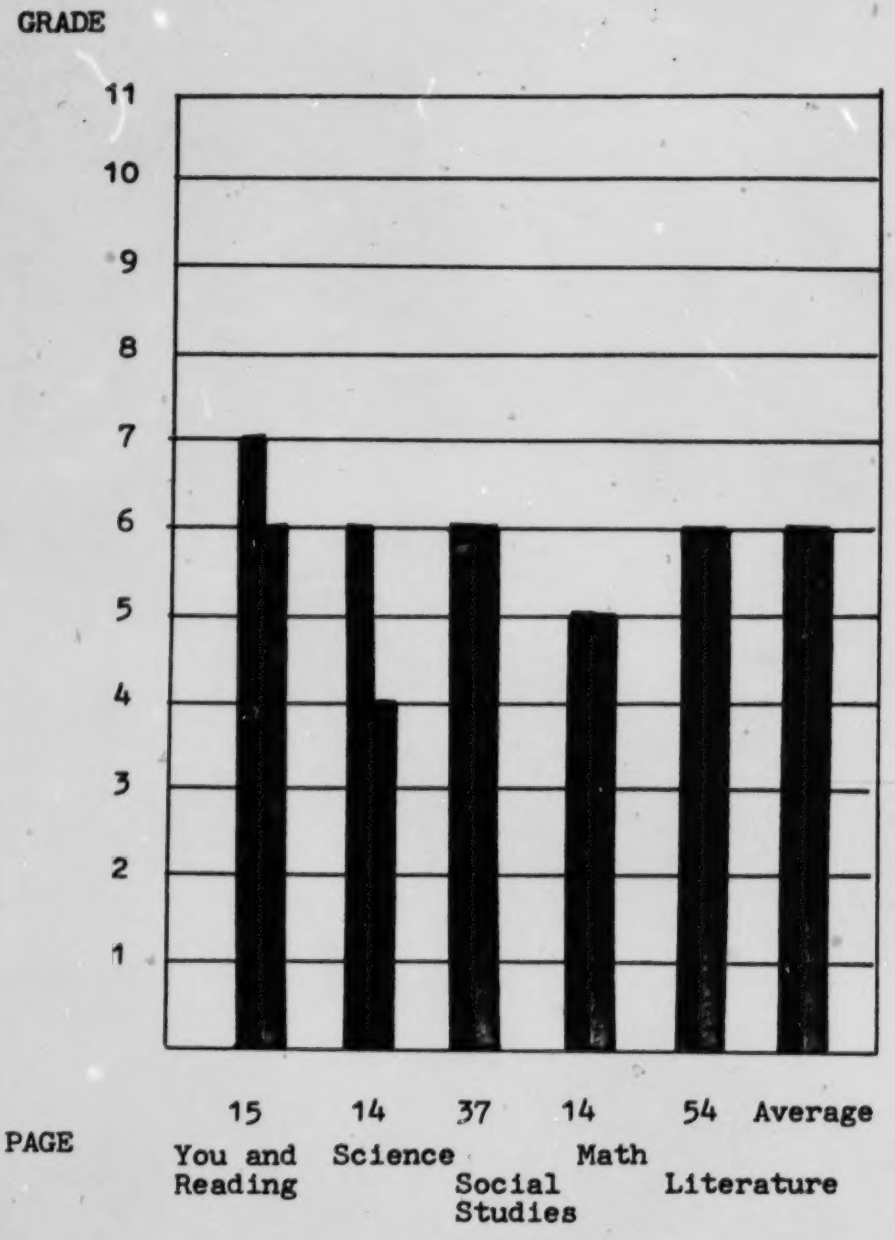


Figure 9 Readability: From Pyramids To Princes

Harper and Row

Level 14

Fry [redacted] Kretschmer [redacted]

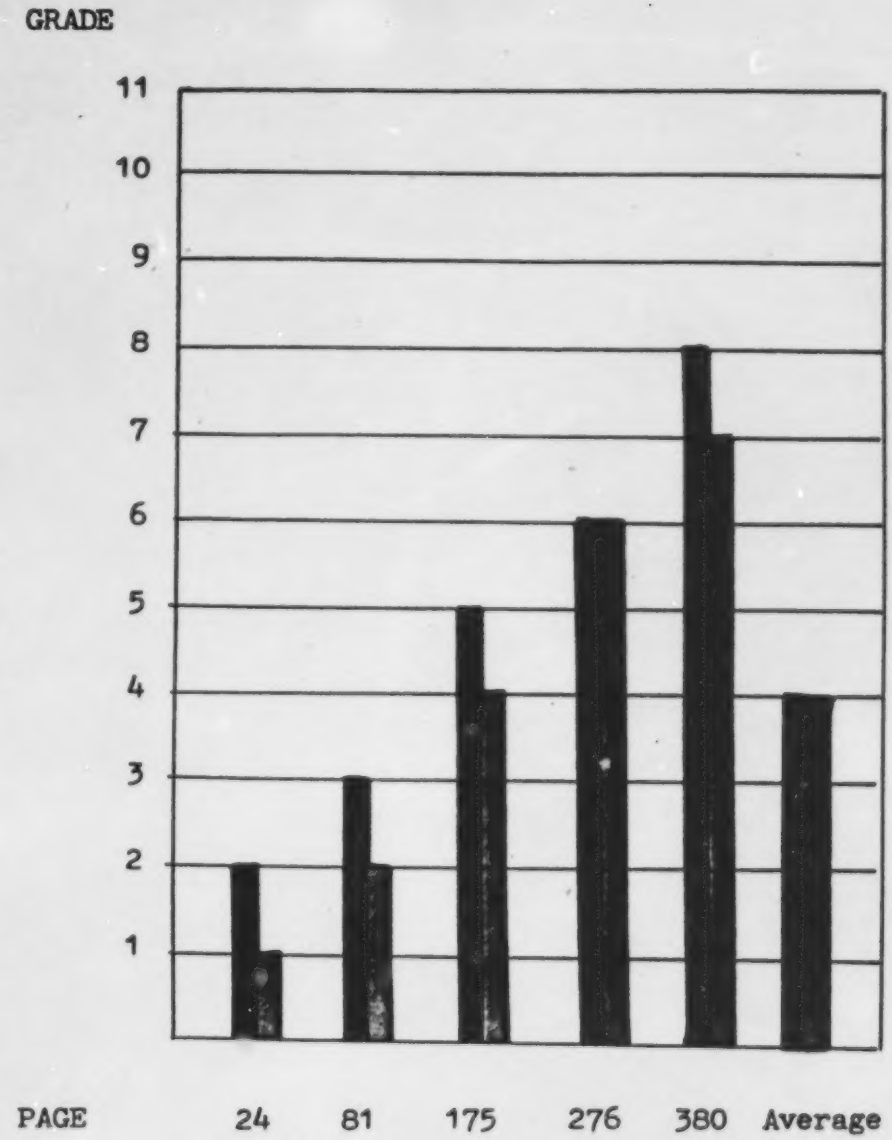


Figure 10 Readability: Coming To Crossroads

Harper and Row

Level 15

Fry ■■■■ Kretschmer ■■■■

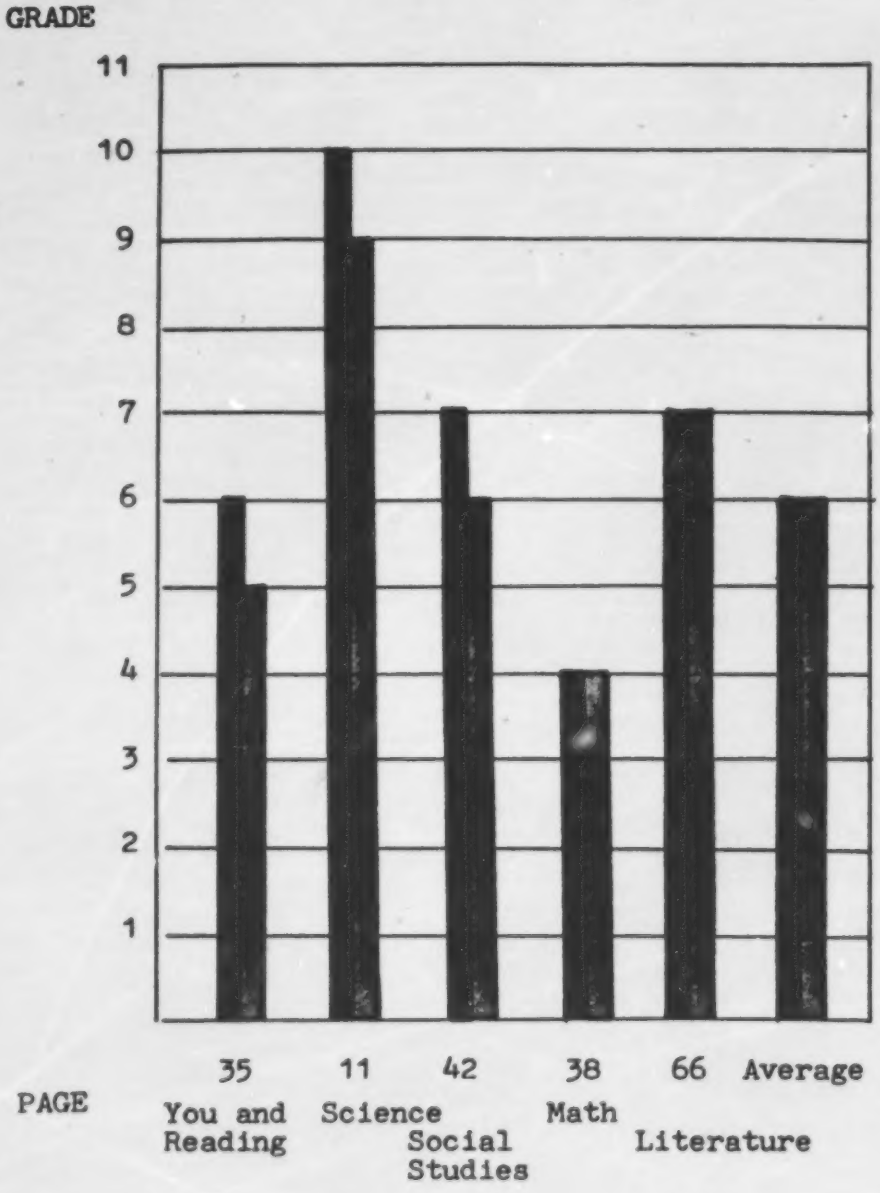


Figure 11 Readability: From Falcons to Forests

Harper and Row

Level 16

Fry ■■■■ Kretschmer ■■■■

and Row have predicted for its usage. However, one passage does go as high as ninth grade and another as low as fourth grade, with the Kretschmer's Correction Formula it decreases to third grade. This is approximately three grade levels above and below the average. (see Figure 12)

Level 18 - From Lions To Legends. From Lions To Legends is recommended for sixth grade reading. It is the final content area basal of this series. Unit one, "You And Reading" appears to be easy at the third grade level, then the readability jumps to eighth grade in science and as high as eleventh grade for social studies. The comprehensive average is seventh grade which is more difficult than the inferred sixth grade situation. (see Figure 13)

An overview, as shown in Figure 14, of the Harper and Row suggested grade levels in relation to the Fry and Kretschmer readability formulas shows that, on the whole, this program is above the average grade levels indicated for their basal readers.

Elementary School Mathematics - Addison-Wesley Publishing Company.

Level 4. The average readability, according to Fry, is fifth grade, the Kretschmer formula lowers that average to fourth grade. Even at fourth grade the readability is too high. In order to develop math concepts, reading of the text should be easy and fluent. This text is very irregular

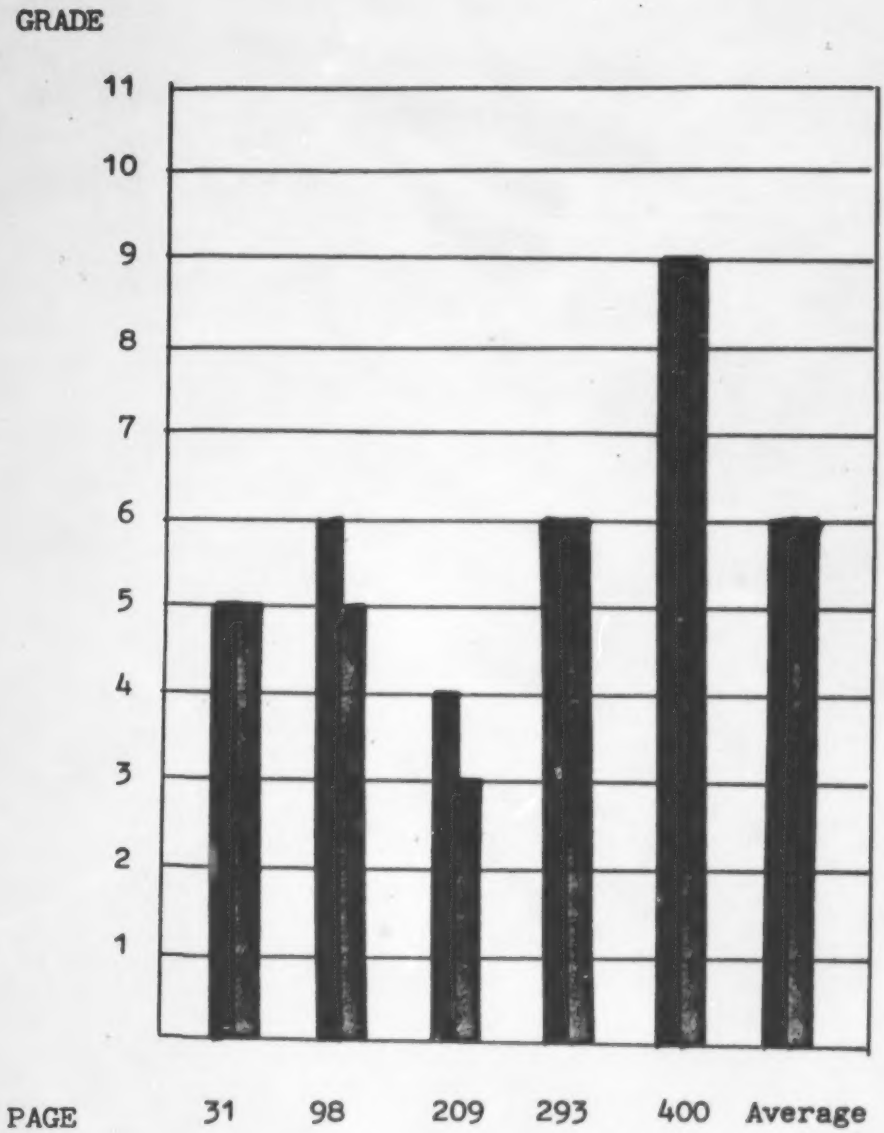


Figure 12 Readability: Spanning The Seven Seas

Harper and Row

Level 17

Fry ▬▬ Kretschmer ▬▬

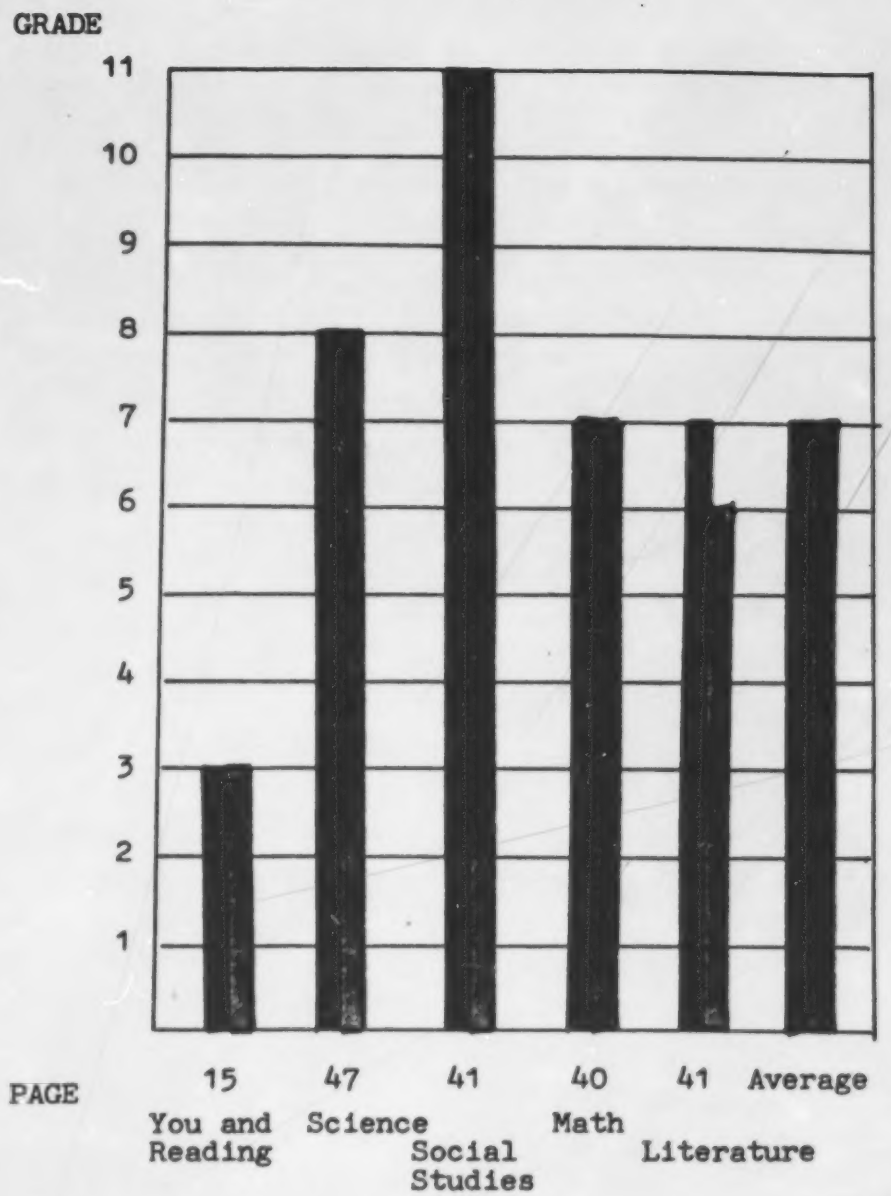


Figure 13 Readability: From Lions to Legends

Harper and Row

Level 18

Fry [redacted] Kretschmer [redacted]

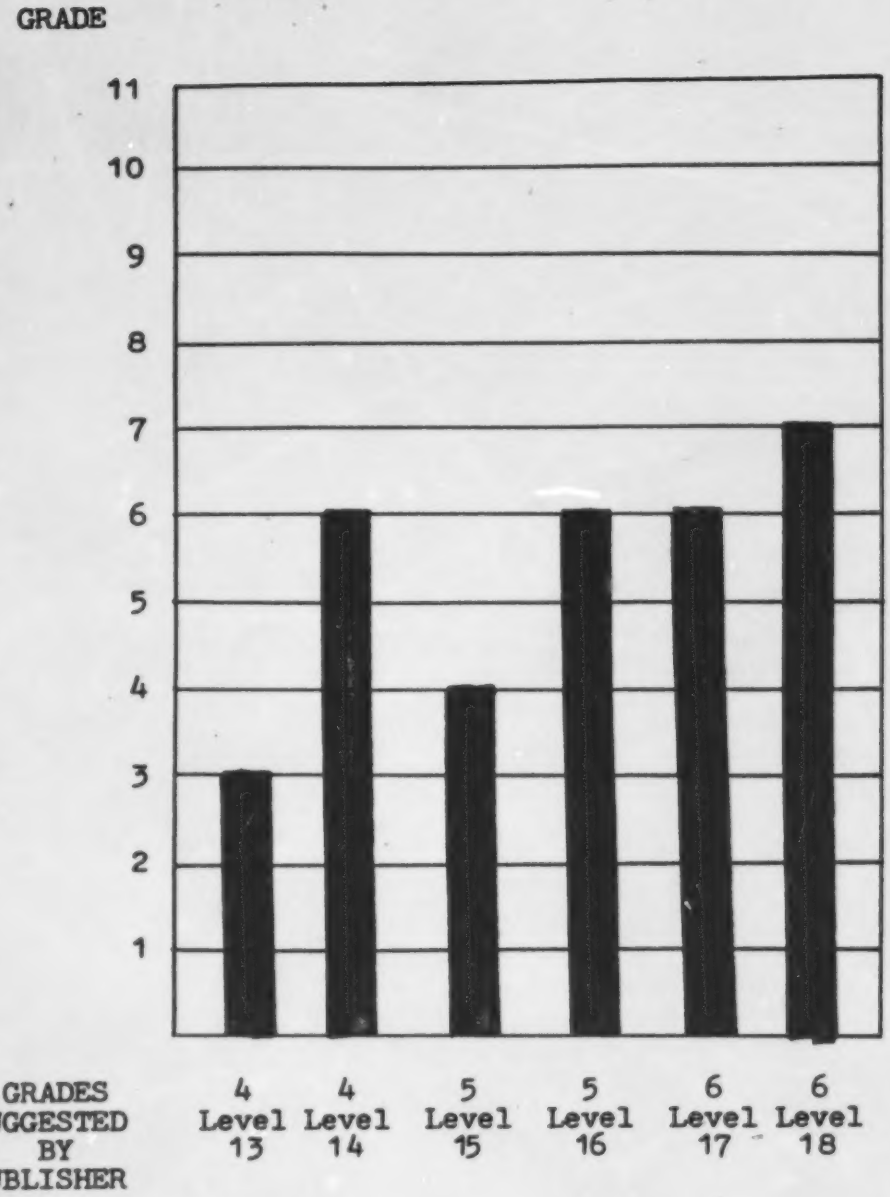


Figure 14 Grade Averages According to Formulas and Publisher Harper and Row

and appears to have a varying degree of difficulty throughout. (see Figure 15)

Level 5. The applied Fry formula estimates this math book to be at the fourth grade readability level, with the Kretschmer correction the average is at third grade. This appears to be an accurate level for a math unit. However, a more detailed examination shows that some areas increase to the sixth grade which is too high for this particular type of text. (see Figure 16)

Level 6. This level averages at the sixth grade level, and all sections are fairly close. The range of the Fry formula shows fifth to seventh grades encompassed in the text. Kretschmer's formula shows a range from third to sixth grades. (see Figure 17)

The Addison-Wesley Elementary School Mathematics texts appear to be suggested for grades slightly above their ease of reading.

Harbrace Mathematics - Harcourt Brace Jovanovich, Inc.

Level 4. The average readability as indicated by the applied formulas shows fourth grade readability for this text. Only two sections, however, are below this level and the remaining three raise to fifth and sixth grade. This particular text appears to be more difficult than what the average readability illustrates. (see Figure 18)

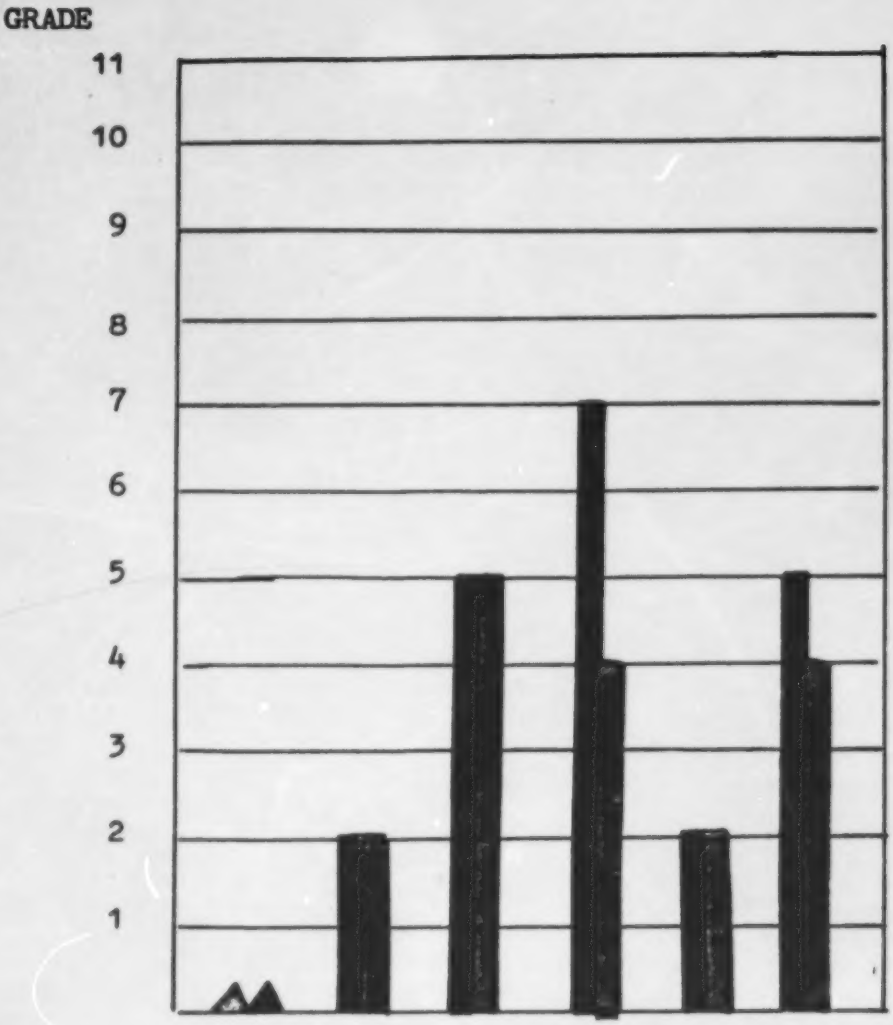


Figure 15 Readability: Elementary School Mathematics

Addison-Wesley Publishing Company

Level 4

Fry [redacted] Kretschmer [redacted]

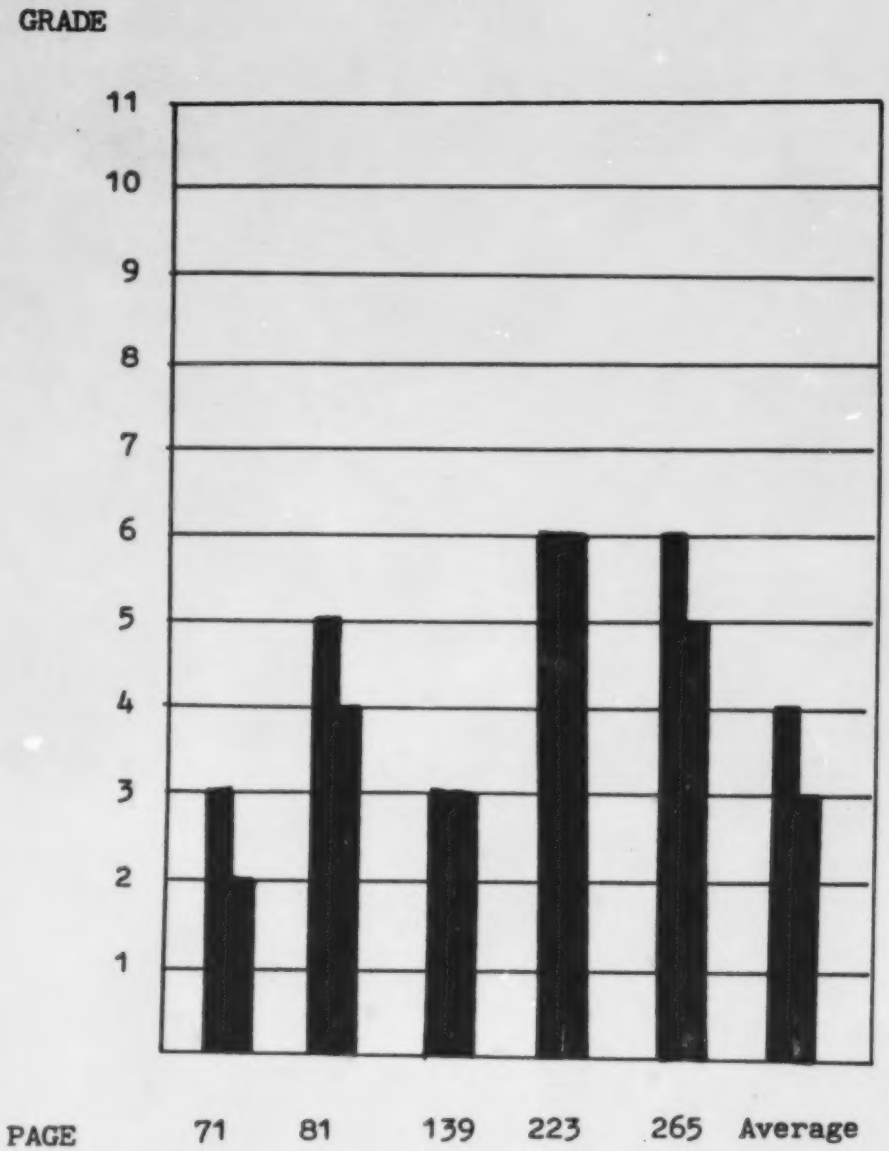


Figure 16 Readability: Elementary School Mathematics

Addison-Wesley Publishing Company

Level 5

Fry [redacted] Kretschmer [redacted]

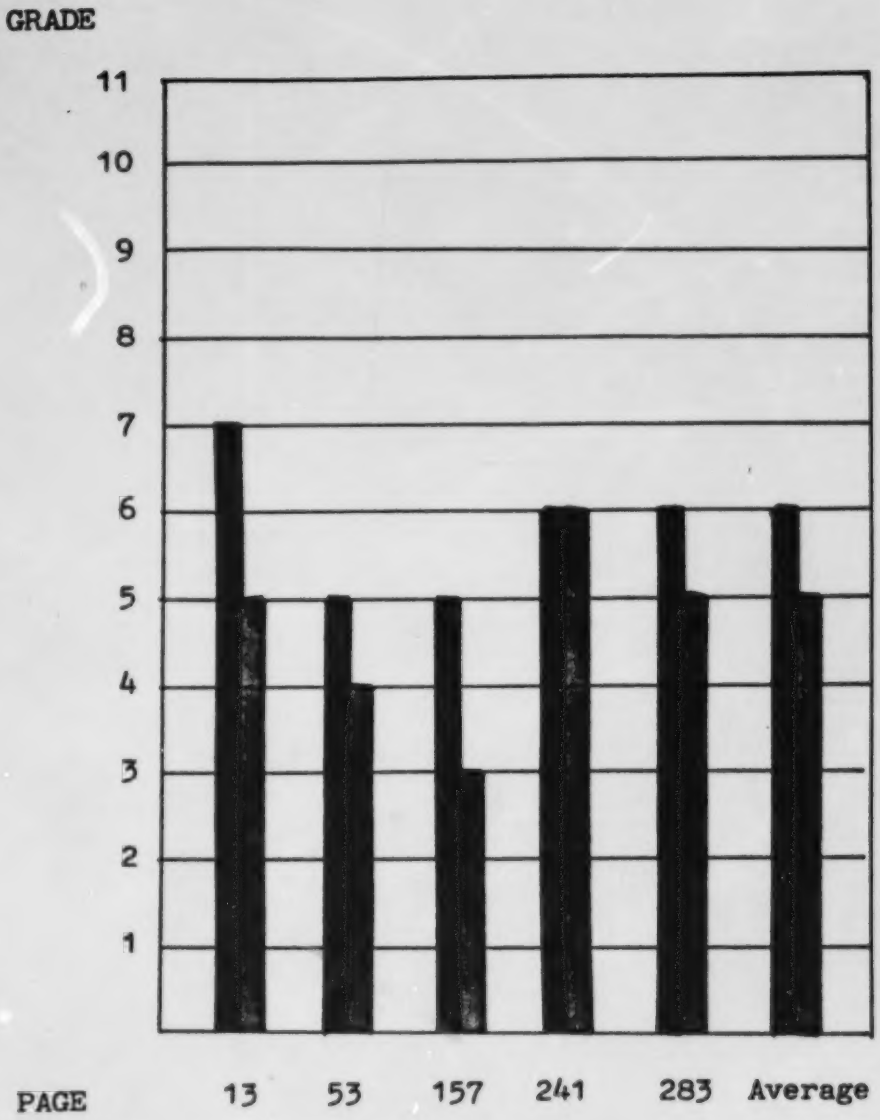


Figure 17 Readability: Elementary School Mathematics

Addison-Wesley Publishing Company

Level 6

Fry [redacted] Kretschmer [redacted]

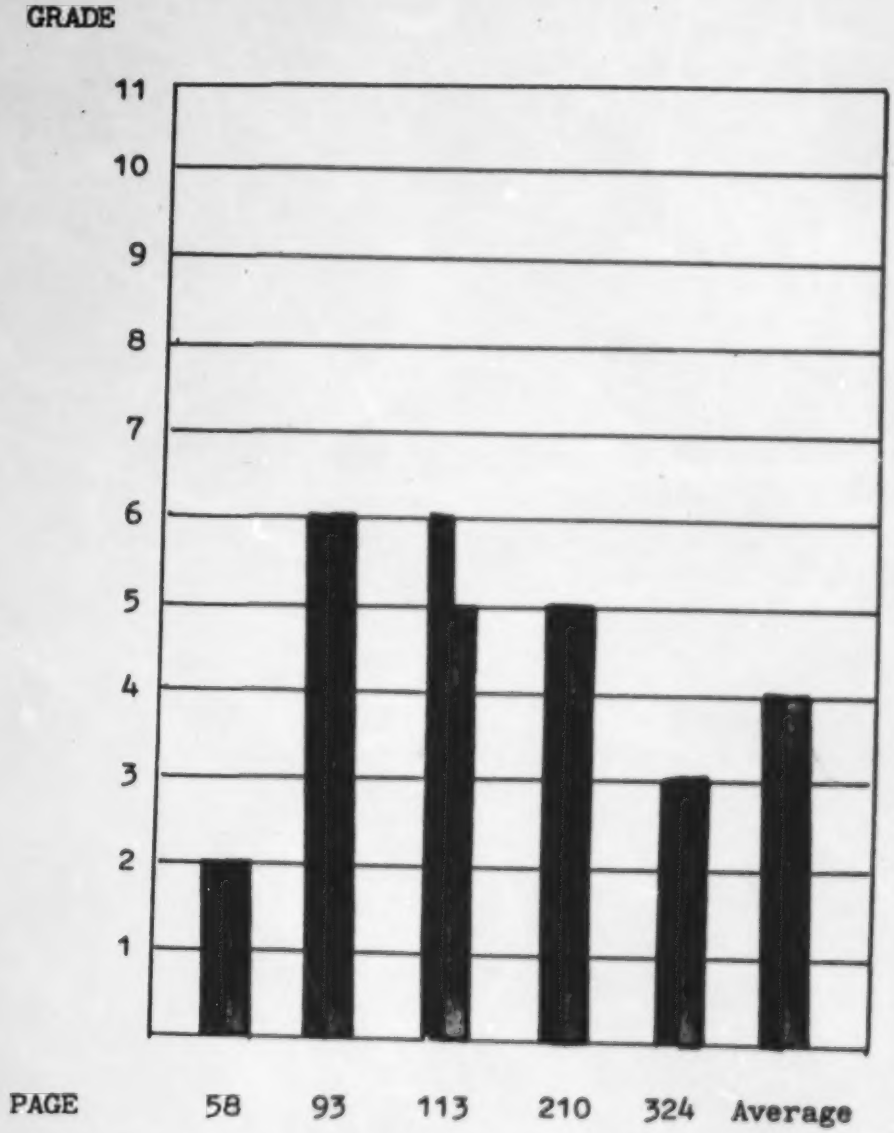


Figure 18 Readability: Harbrace Mathematics

Grade 4

Fry ▬▬ Kretschmer ▬▬

Level 5. In general, the readability of this math book is at the fourth grade level. Most sections are below the actual grade placement, allowing for more concentration in the mathematical concepts. Page 110 of this text reaches sixth grade which is too difficult. All other areas sampled appear acceptable and in conjunction with the publishers estimated grade level. (see Figure 19)

Level 6. This sixth grade math text has a fifth grade readability level according to both the Fry and Kretschmer formulas. Three of the five randomly selected pages were either at or below fifth grade. Two pages increased above this average, although most of this text is satisfactorily applied for use in sixth grade. (see Figure 20)

The Harbrace Mathematic Textbooks appear to be within the relm of acceptance for most of its readability levels. The uneven structure of these units could cause difficulty, many selections should be easily read and comprehended with a readability one grade level lower than the actual grade placement.

SUMMARY

In general, the basal texts analyzed show a vast diversity not only among each other, but among themselves as well. Most texts tend to span many years within one grade unit, thus resulting in an average grade which is not

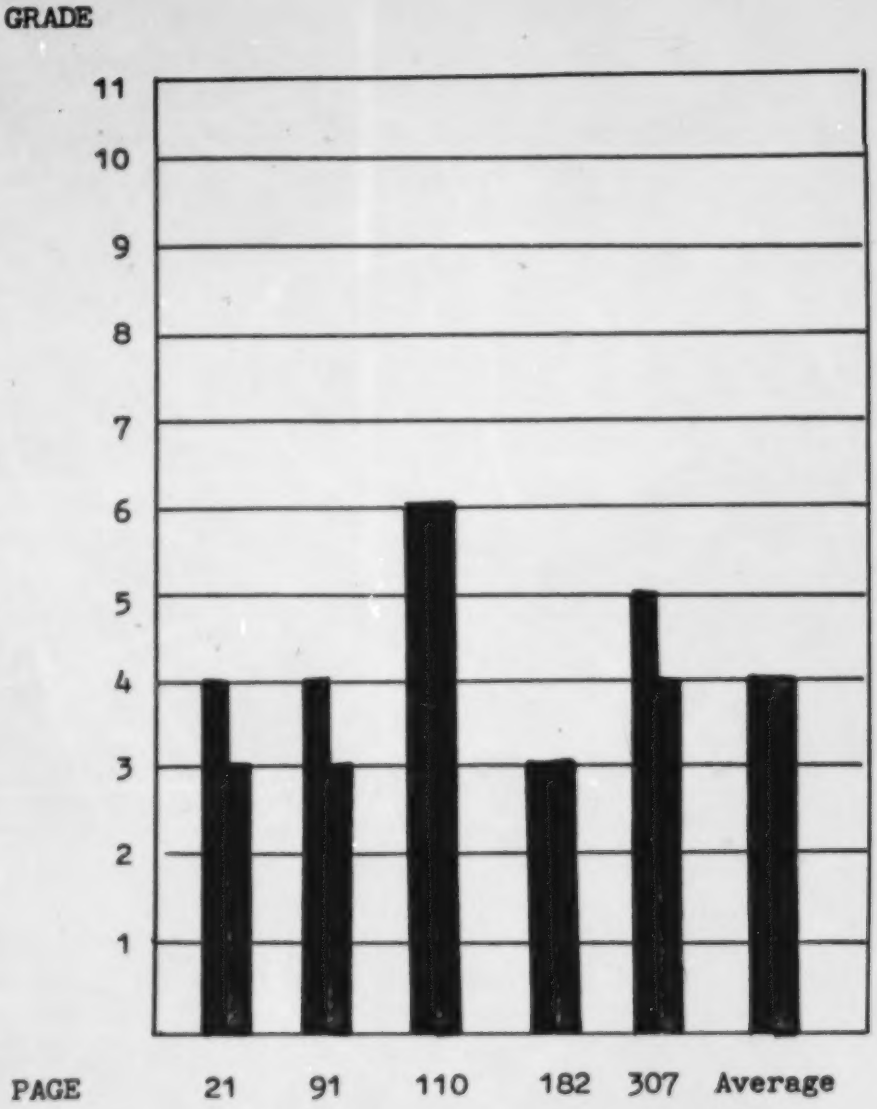


Figure 19 Readability: Harbrace Mathematics Grade 5

Fry ▬ Kretschmer ▬

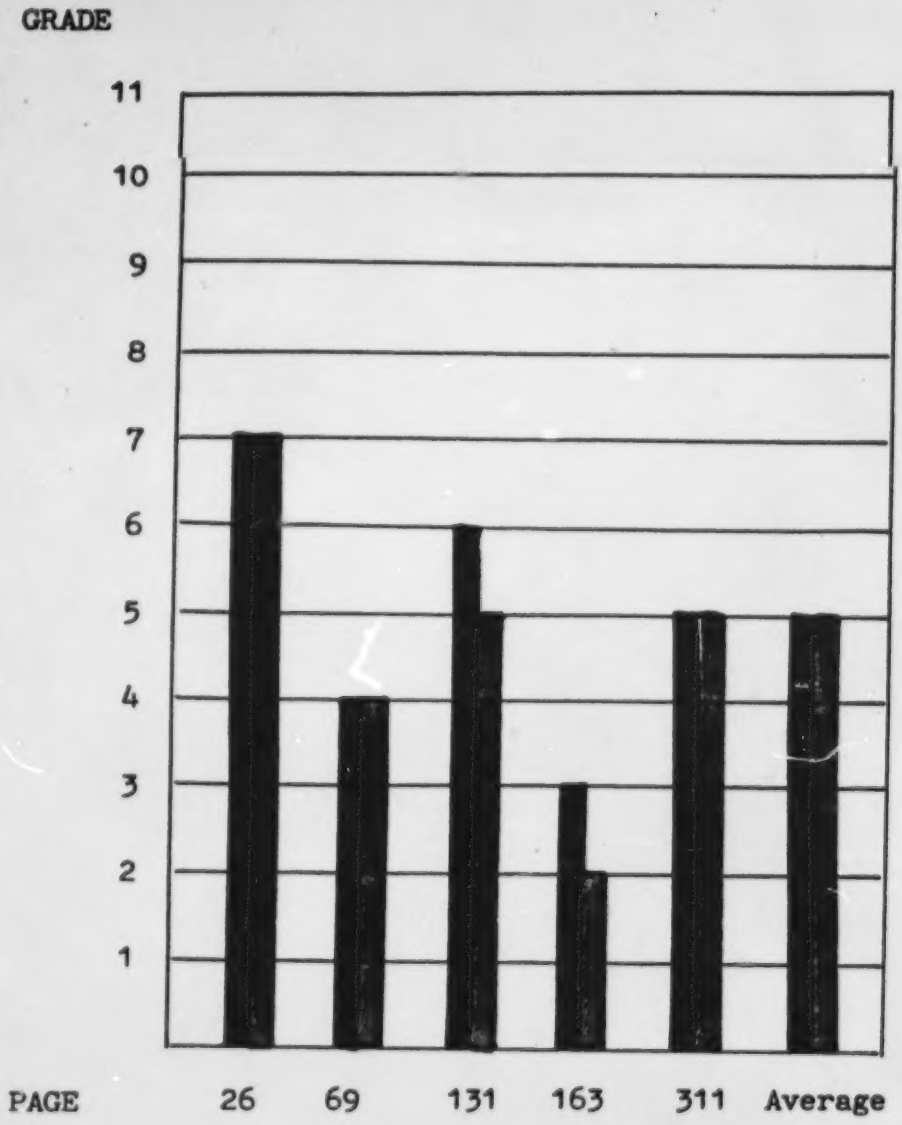


Figure 19 Readability: Harbrace Mathematics Grade 6

Fry [redacted] Kretschmer [redacted]

really appropriate or conducive to learning. Within one text as much as seven years readability can be covered.

This study also indicates that most textbooks do not progress systematically from easy material to more difficult information. Most figures shown in this research have a roller coaster appearance which indicates the uneven spread of knowledge and the diversity of pace included in each level.

Although readability does not measure concept load, or vocabulary development, it does indicate the complexity of sentence structure which is exposed to students every day. This researcher feels that a readability of units being taught can only be beneficial. Publishers should express the readability of a text unit by unit rather than an overall general average which could prove to be of no significant value.

CHAPTER V

SUMMARY AND CONCLUSIONS

INTRODUCTION

Evaluating textbooks according to their readability is a very useful tool. Many educators find themselves in teaching situations where required course textbooks are predetermined by the administration. Once the instructor is aware of both the class reading level and the difficulty range of the manual, provisions can be made accordingly.

Other circumstances find teachers involved in committees recommending basal series for particular grade levels. Substantial evidence should be provided for both acceptance or rejection of each textbook. Readability can be used as one criteria in the assessment procedure.

The succeeding chapter explains the various conclusions drawn from the data accumulated and analyzed on the two reading and two math series previously discussed.

RESTATEMENT OF THE PROBLEM

Are math and reading series appropriately matched to actual grade level fluency and individual students' reading levels?

DESCRIPTION OF PROCEDURES USED

To establish the readability level of the basals, the Fry Readability Graph and the Kretschmer Correction Formula were administered. Five samples were taken from each text and compared to the publishers' suggested usage according to grade level. These comparisons were illustrated in graphic forms for easy evaluation.

PRINCIPAL FINDINGS AND CONCLUSIONS

This research was based on the null hypothesis that there would be no significant difference between the readability level suggested by the manufactured texts and actual computations of readability formulas. This hypothesis is accepted for all four publishing companies. The Ginn 360 Reading Series, Addison-Wesley Elementary School Mathematics, and the Harbrace Mathematic textbooks all have average readability estimates within one grade of the publishers' suggested level. Five of the six levels examined in the Harper and Row reading series fell within one grade of their recommended placement. Only Level 14, a fourth grade text, appeared to have a sixth grade readability, which is two steps higher than the actual textbook classification. Although these formulas agreed with the publishers recommended usage, the vast range found within each unit gives a different perspective on the general averages.

This researcher has found that no one particular basal has a sole readability level and cannot, therefore, be accurately designated as a single grade leveled book. Each text has several different levels, many vary from unit to unit, and a change can even occur within a story. With this consideration, a general readability is only worth its surface value. To be specifically useful publishers should give a readability estimate for each new story, or check to make sure every unit included within a graded basal accurately be coded for that level.

It is further concluded that no textbook should be accepted according to its general readability average. The series should be weighed in relation to its span of diversity within each text and the type of student expected to succeed in the program.

Instructors should be aware of this vast range and scope of readability encompassed within a basal. Once this has been acknowledged greater emphasis could be devoted to the higher levels of difficulty and independent study could be initiated for easier units.

Therefore, when considering a textbook for any course of study, it would be wiser to look at specific unit readability levels rather than the general statistical average.

RECOMMENDATIONS FOR FURTHER INVESTIGATION

It might be beneficial to analyze the basals by using other formulas such as the Dale-Chall Formula and the cloze procedure to determine the accuracy of these results. Other texts could be observed to find out if this is a general trend or whether these cases are unique.

It would also be interesting to contact publishing companies to determine their rationale for this great diversity of readability units within a given graded manual.

BIBLIOGRAPHY

BUSH, CLIFFORD L. and ROBERT C. ANDREWS. Dictionary of Reading and Learning Disabilities Terms. New Jersey: Educational and Psychological Associates Press, 1973. p. 68.

CARDINELL, C. F. "Rewriting Social Studies Materials To Lower Reading Levels," The Reading Teacher, 30:168-72, November 1976.

DALE, EDGAR and JEANNE S. CHALL. "A Formula for Predicting Readability," Educational Research Bulletin, 27:11-20, January 21, 1948.

DORWART, GLORIA. "A Comparison of Trade Books and Special Series Books for Remedial Readers," Unpublished Article ERIC: ED 124 891, 1976.

FEINBERG, WALTER. "The Teacher and His Materials: A View of Accountability From The Inside," The Elementary School Journal, 73:350, April 1973.

FRY, EDWARD. The Emergency Reading Teacher's Manual. New Jersey: Dreier Educational Systems, Inc., 1969. p. 16.

FRY, EDWARD. "A Readability Formula That Saves Time," Journal of Reading, 11:577, April 1968.

HEDDENS, JAMES W. and KENNETH J. SMITH. "The Readability of Elementary Mathematics Books," The Arithmetic Teacher, 11:466-8, November 1964.

JOHNSON, ROGERS E. "The Reading Level of Elementary Social Studies Textbooks is Going Down," The Reading Teacher, 30:901, May 1977.

JONGSMA, EUGENE A. "The Difficulty of Children's Books: Librarians' Judgments Versus Formula Estimates," Elementary English, 49:20-6, January 1972.

JORGENSON, GERALD W. "An Analysis of Teacher Judgments of Reading Level," American Educational Research Journal, 12:67-75, Winter 1975.

KLARE, GEORGE. The Measurement of Readability. Iowa: Iowa State University Press, 1963. p. 38-9.

KLARE, GEORGE. "Assessing Readability," Reading Research Quarterly, 10:62-102, 1974-5.

KRETSCHMER, JOSEPH C. "Updating the Fry Readability Formula," The Reading Teacher, 29:555-8, March 1976.

LIVELY, BERTHA A. and S. L. PRESSEY. "A Method For Measuring The Vocabulary Burden of Textbooks," Educational Administration and Supervision, 9:389-98, October 1923.

LORGE, IRVING. "Readability Formulae - An Evaluation," Elementary English, 26:86-95, February 1949.

PAUK, WALTER. "A Practical Note on Readability Formulas," Journal of Reading, 13:207-10, December 1969.

PETERS, MARY L. "My Weekly Reader...Can I Read It?," Learning Today, 8:43-4, Summer 1975.

SMITH, FRANK. "The Readability of Junior High School Mathematics Textbooks," The Mathematics Teacher, 62:289-91, April 1969.

SMITH, KENNETH J. "The Application of Readability Formulae to Mathematics Text Materials: A Note," The Arithmetic Teacher, 12:304-5, October 1964.

SMITH KENNETH J. and JAMES W. HEDDENS. "The Readability of Experimental Mathematics Materials," The Arithmetic Teacher, 11:392, October 1964.

TINKER, MILES A. and CONSTANCE M. MC CULLOUGH. Teaching Elementary Reading. New York: Appleton-Century-Crofts, 1968. p. 302.

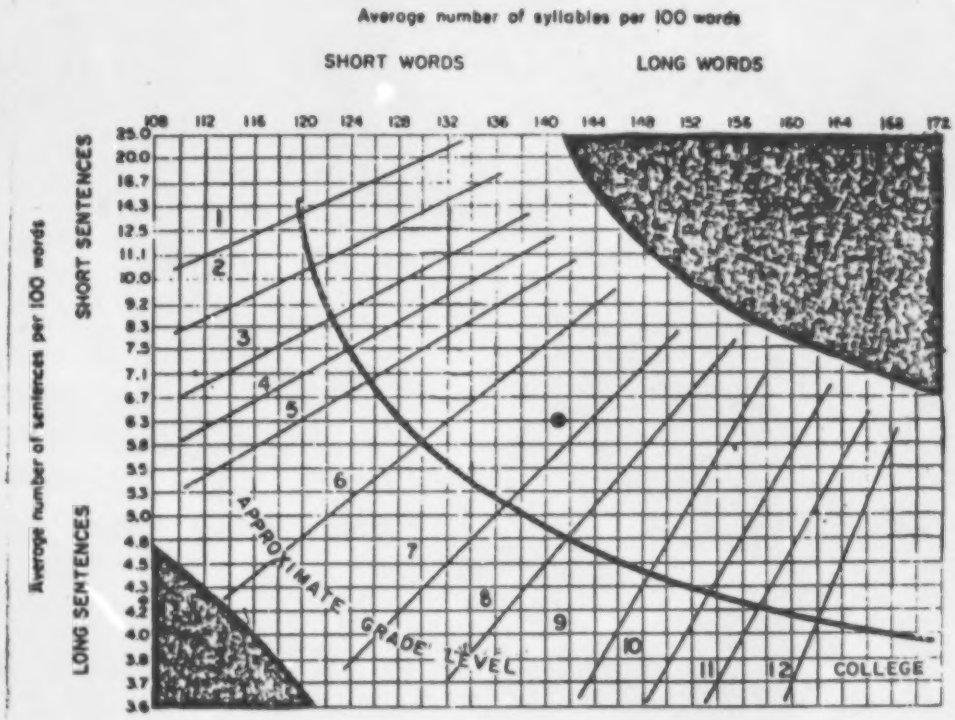
VAUGHN JR., JOSEPH L. "Interpreting Readability Assessments," Journal of Reading, 19:635-9, May 1976.

WIEGAND, REGIS B. "Pittsburgh Looks at the Readability of Mathematics Textbooks," Journal of Reading, 11:201-4, December 1967.

APPENDIX A

GRAPH FOR ESTIMATING READABILITY

BY EDWARD FRY



DIRECTIONS: Randomly select 3 one hundred word passages from a book or an article. Plot average number of syllables and average number of sentences per 100 words on graph to determine the grade level of the material. Choose more passages per book if great variability is observed and conclude that the book has uneven readability. Few books will fall in gray area but when they do grade level scores are invalid. Do not count numerals. Do not count proper nouns.

EXAMPLE:

	SYLLABLES	SENTENCES
1st Hundred Words	124	6.6
2nd Hundred Words	141	5.5
3rd Hundred Words	158	6.8
AVERAGE	141	6.3

READABILITY 7th GRADE (see dot plotted on graph)

APPENDIX B

KRETSCHMER'S LIST OF FIFTY EASY WORDS

about
after
again
ago
almost
along
also
always
another
any
anything
around
away
because
before
better
city
ever
every
family
father
funny
going
happy
into
little
many
mother
morning
money
myself
never
o'clock
only
open
other
over
people
pretty
second
seven
something
today
under
upon
until
very
woman
yellow
yesterday

APPENDIX C

GINN AND COMPANY (360 READING)

READABILITY ANALYSIS

Textbook: All Sorts of Things

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
32	9	122	114	3	3
98	9.5	117	112	3	2
174	13	131	129	3	3
246	11	120	117	2	2
317	14	128	123	2	2
			Total Book:	3	3

Textbook: The Sun That Warms

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
27	9	123	117	3	3
68	4	126	123	7	7
169	10	116	113	2	2
251	8.5	119	117	3	3
374	8.5	124	119	4	3
			Total Book:	4	3

Textbook: On The Edge

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
49	4.5	140	132	7	7
101	5.8	120	115	6	5
189	5.3	119	117	6	6
269	7.5	130	124	5	5
407	6	125	124	6	6
			Total Book:	6	6

Textbook: To Turn A Stone

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
55	8.5	122	121	4	3
143	5.5	132	130	7	7
232	4.5	141	134	9	8
346	6.5	110	108	4	4
432	4	130	125	8	7
			Total Book:	6	6

APPENDIX D

HARPER AND ROW

READABILITY ANALYSIS

Textbook: Traveling The Trade Wind

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
21	5.5	130	119	7	6
92	17.2	148	148	No Grade	No Grade
205	17	121	120	1	1
281	9	124	122	4	3
372	5	133	132	7	7
			Total Book:	3	3

Textbook: From Pyramids to Princes

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
15 (You and Reading)	5.5	128	123	7	6
14 (How to Read Science)	7	129	120	6	4
37 (How to Read Social Studies)	8	140	139	6	6
22 (How to Read Mathematics)	9	135	134	5	5
54 (How to Read Literature)	6.5	129	128	6	6
			Total Book:	6	6

Textbook: Coming To Crossroads

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
24	16	130	124	2	1
81	10	122	116	3	2
175	10	138	132	5	4
276	8.2	133	133	6	6
380	5.5	143	139	8	7
			Total Book:	4	4

Textbook: From Falcons To Forests

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
35 (You and Reading)	5.75	118	112	6	5
11 (How to Read Science)	7.5	160	157	10	9
42 (How to Read Social Studies)	7	139	134	7	6
38 (How to Read Mathematics)	11.5	139	139	4	4
66 (How to Read Literature)	3.75	122	121	7	7
			Total Book:	6	6

Textbook: Spanning The Seven Seas

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
31	7.75	130	128	5	5
98	6.5	125	120	6	5
209	10	129	125	4	3
293	6.5	127	124	6	6
400	4	144	140	9	9
			Total Book:	6	6

Textbook: From Lions To Legends

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
15 (You and Reading)	8	120	112	3	3
47 (How to Read Science)	5	143	142	8	8
41 (How to Read Social Studies)	5.75	164	160	11	11
40 (How to Read Mathematics)	8	146	142	7	7
41 (How to Read Literature)	6.5	134	130	7	6
			Total Book:	7	7

APPENDIX E

ADDISON-WESLEY PUBLISHING COMPANY

READABILITY ANALYSIS

Textbook: Grade 4

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
11	11.5	162	155	No Grade	No Grade
55	13.5	128	120	2	2
152-3	8.5	134	132	5	5
231	8.75	143	128	7	4
279	11	118	117	2	2
			Total Book:	5	4

Textbook: Grade 5

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
71	11.5	124	121	3	2
81	7.5	124	121	5	4
139	11	133	131	3	3
223	7	132	127	6	6
265	6.75	130	122	6	5
			Total Book:	4	3

Textbook: Grade 6

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
13	9.5	147	135	7	5
53	12.5	144	139	5	4
157	9	133	122	5	3
241	7	131	129	6	6
283	8	138	132	6	5
			Total Book:	6	5

APPENDIX F

HARBRACE MATHEMATICS

READABILITY ANALYSIS

Textbook: Grade 4

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
58	14.5	123	114	2	2
93	9	141	139	6	6
113	9	137	132	6	5
210	9	136	133	5	5
324	11	129	127	3	3
			Total Book:	4	4

Textbook: Grade 5

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
21	9.5	126	119	4	3
91	7	114	109	4	3
110	7.5	135	133	6	6
182	8.5	122	119	3	3
307	9.5	133	130	5	4
			Total Book:	4	4

Textbook: Grade 6

Page	Number of Sentences	Number of Syllables (Fry)	Number of Syllables (Kretschmer)	Fry Average	Kretschmer Average
26	9.66	150	150	7	7
69	9	130	128	4	4
131	8	135	132	6	5
163	13.62	130	128	3	2
311	11	140	139	5	5
			Total Book:	5	5